

Pearl River Delta
Regional Air Quality Monitoring Network

A Report of Monitoring Results in 2012

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Report Prepared by : **Guangdong Provincial
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**Environmental Protection
Department, HKSAR**

Approved by : **Pearl River Delta Air Quality
Management and Monitoring
Special Panel**

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Purpose of the Report

This report provides the 2012 monitoring results from the Pearl River Delta Regional Air Quality Monitoring Network and their statistical analysis.

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1. Introduction to the Pearl River Delta Regional Air Quality Monitoring Network

The Pearl River Delta (PRD) Regional Air Quality Monitoring Network (the Network) was jointly established by the Guangdong Provincial Environmental Monitoring Centre (GDEMC) and the Environmental Protection Department of the Hong Kong Special Administrative Region (HKEPD) from 2003 to 2005. The Network came into operation on 30 November 2005 and its data have been used for reporting Regional Air Quality Index (RAQI) to the public since then.

The Network comprises 16 automatic air quality monitoring stations (see Figure 1) across the PRD region. Ten of these stations are operated by the Environmental Monitoring Centres of the individual cities in Guangdong while the three stations located in Hong Kong are managed by the HKEPD. The remaining three regional stations in the Network are operated by the GDEMC. The objectives of the Network are to :

- provide accurate air quality data that can help the Guangdong Provincial and HKSAR governments to appraise the air quality situation and pollution problems in the PRD region for formulating appropriate control measures;
- evaluate the effectiveness of the air pollution control measures through long-term monitoring;
- provide the public with information on the air quality of various places in the region.

In order to ensure that the air quality monitoring results attain a high degree of accuracy and reliability, the two governments had jointly developed a set of “Standard Operating Procedures on Quality Assurance and Quality Control of the PRD Air Quality Monitoring System for Hong Kong and Guangdong” (QA/QC Operating Procedures). The design and operation of the Network comply with the requirements set out in the QA/QC Operating Procedures.

All stations are installed with equipment to measure the ambient concentrations of respirable suspended particulates (PM₁₀ or RSP), sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and ozone (O₃).

Annexes A and B set out, respectively, the site information of the monitoring stations in the Network and the methods used for measuring air pollutant concentrations.



Figure 1 : Spatial distribution of the PRD Regional Air Quality Monitoring Stations

2. Operation of the Network

Owing to the extensive renovation work at the Guangzhou Nansha Wanqingsha air monitoring station, the station was temporarily suspended from operation in 2012. In addition, the Dongguan Haogong Primary School monitoring station was relocated to Nanchengyuanling in the vicinity and renamed Nanchengyuanling station ¹ from 1 January 2012 because the representativeness of the original site had been affected by urban development in the locality. The Zhuhai Tangjia monitoring station, after obtaining the approval of the Ministry of Environmental Protection, was also relocated from the site at Zhongshan University to the nearby Qiao Island ² from 1 March 2012. The move was a result of the expansion cum adjustment of the Zhuhai air monitoring network.

The operation of the Network was generally smooth in 2012. Excluding the suspended Wanqingsha station, the average data capture rates of all other monitoring stations in the Network was 95%.

In order to provide the public in both Guangdong and HKSAR with information on the daily air quality of different parts of the PRD region, the GDEMC and HKEPD established a daily reporting system of the Regional Air Quality Index (RAQI). The two Governments have been issuing the RAQI to the public at 4pm every day through the Internet since 30 November 2005.

2.1 Quality Control (QC) and Quality Assurance (QA) Activities

The two governments have fully implemented the agreed QA/QC programme, which include zero/span checks, precision checks, dynamic calibration, etc., in accordance with the QA/QC Operating Procedures so as to ensure that the air quality data from the monitoring stations are highly accurate and reliable. To ensure the operation of the Network in compliance with the QA/QC requirements, the GDEMC and HKEPD have jointly set up the Guangdong-Hong Kong Quality Management Committee for the PRD Regional Air Quality Monitoring Network (the Quality Management Committee, QMC) to review, on a quarterly basis, the set-up of the network, its performance in QA/QC and the operation of its data transmission system. The QMC also conducts system audit once a year to evaluate the effectiveness of the quality management system. The QMC prepares a report summarizing the findings of the system audit including the deficiencies found, and take appropriate corrective measures.

2.2 Accuracy and Precision

The accuracy of the Network is assessed by means of performance audits. The control limits set for the gaseous pollutants and respirable suspended particulates (PM₁₀) are $\pm 15\%$ and $\pm 10\%$ respectively, these limits are similar to those of the United States Environmental Protection Agency and other international standards. In 2012, the GDEMC and HKEPD jointly carried out 343 audit checks on the analysers and samplers at the monitoring stations of the Network. The results showed that, based on the 95% probability limits, the accuracy of the Network varied between -10.7% to 13.2% and was within the specified control limits (see Figure 2).

Precision is a measure of repeatability and is calculated in accordance with the QA/QC Operating Procedures. The control limits adopted for the gaseous pollutants and respirable suspended particulates (PM₁₀) are $\pm 20\%$ and $\pm 10\%$ respectively. In 2012, the GDEMC and HKEPD jointly carried out 1453 precision checks on the analysers and samplers at the monitoring stations of the Network. The results showed that, based on the 95% probability limits, the precision of the Network varied between -11.8% and 12.3% and was within the specified control limits (see Figure 3). Overall,

¹ Before the relocation of the Dongguan Haogong Primary School station to Nanchengyuanling, the Dongguan Environmental Monitoring Centre carried out study on the air quality at the new site. The study confirmed that the new site met the siting criteria of the network and the air quality data measured at the old and new sites exhibited a very high degree of correlation. Therefore, the relocation has little impact on the representativeness and data continuity of the monitoring network.

² Before the relocation of the Zhuhai Tangjia monitoring station from Zhongshan University to Qiao Island, Zhuhai Environmental Monitoring Center carried out study on the air quality at the new site. The study confirmed that the new site met the siting criteria of the network and the air quality data measured at the old and new sites exhibited a very high degree of correlation. Therefore, the relocation has little impact on the representativeness and data continuity of the monitoring network

the QA/QC performance of the monitoring network was good in 2012, and met all the requirements specified in the QA/QC Operating Procedures.

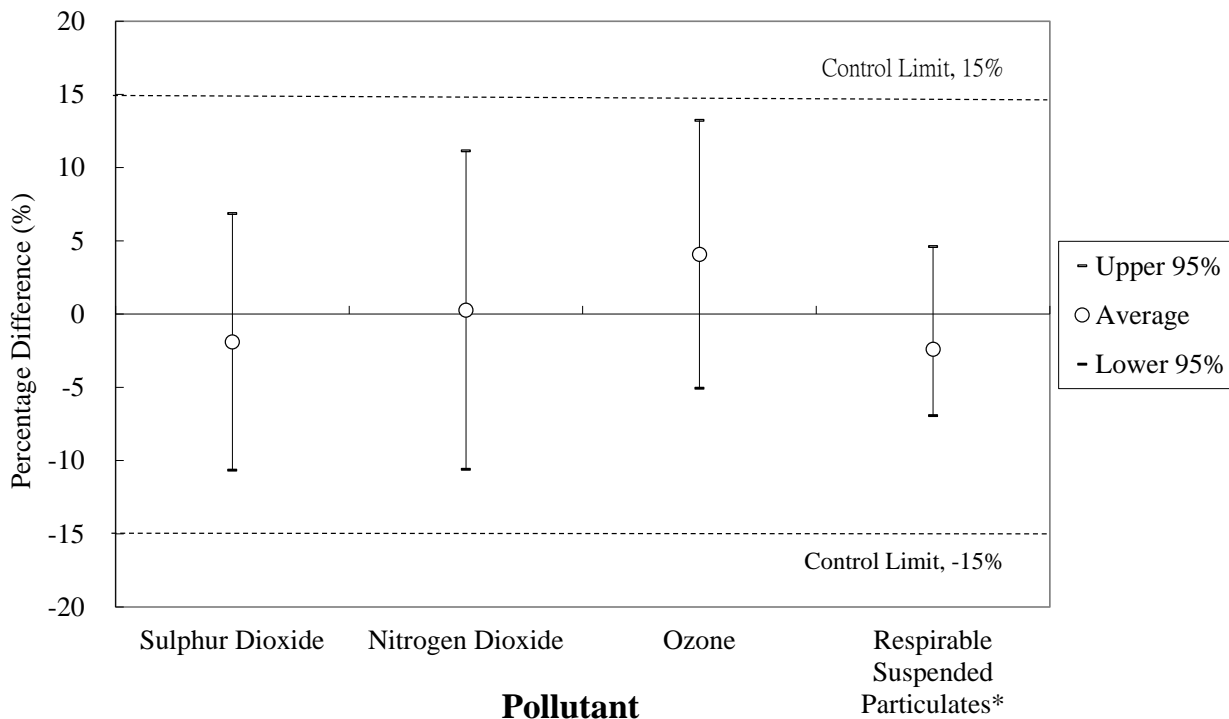


Figure 2 : Accuracy of the PRD Regional Air Quality Monitoring Network in 2012

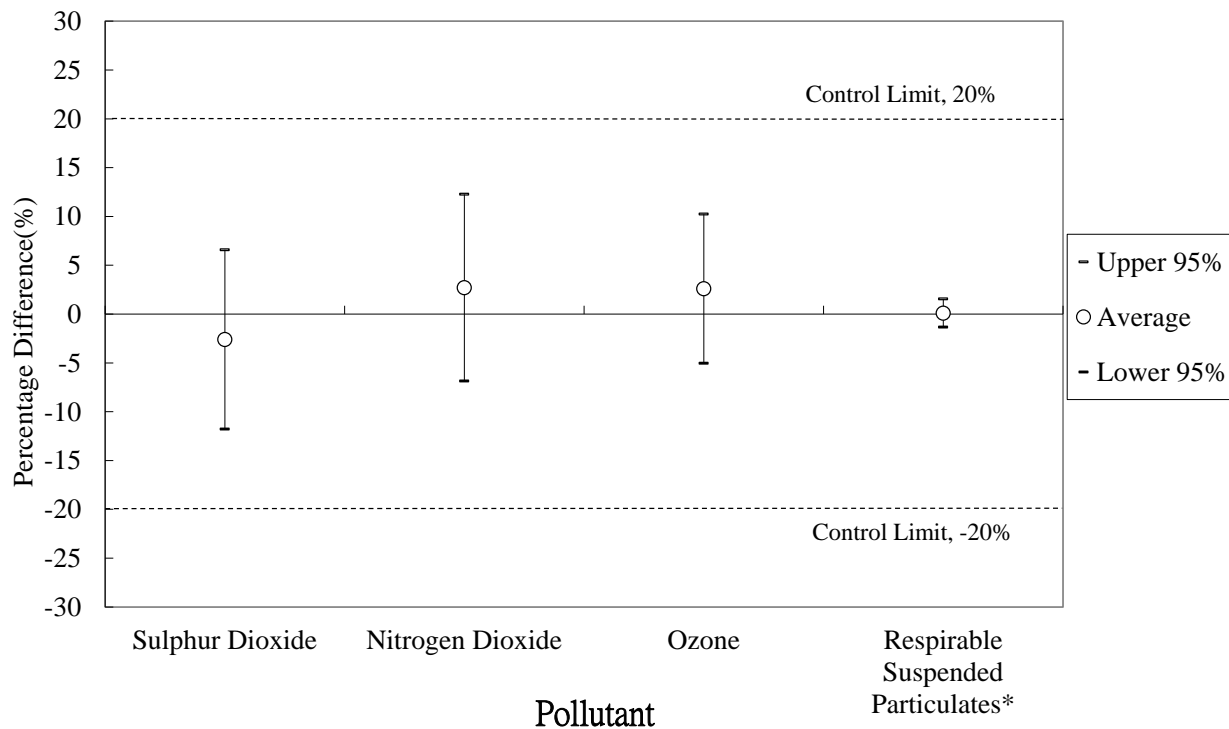


Figure 3 : Precision of the PRD Regional Air Quality Monitoring Network in 2012

* Both the accuracy and precision of the respirable suspended particulates (PM₁₀) adopt a control limit of ±10%.

3. Statistical Analysis of Pollutant Concentrations

3.1 Sulphur Dioxide (SO₂)

Sulphur dioxide (SO₂) comes mainly from the combustion of sulphur-containing fossil fuel. Its major sources of emissions include power plants, fuel combustion plants, vehicles and vessels. Apart from its impact on the human respiratory system, SO₂ can also be oxidized in the air to form sulphate, which has significant impact on the levels of respirable suspended particulates (PM₁₀), acid rain and visibility in the region.

The annual averages of SO₂ at various monitoring stations in the Network ranged from 0.007 mg/m³ to 0.037 mg/m³ in 2012; all were in compliance with the national annual air quality standard³ (0.06 mg/m³). As shown in Figure 4, the average levels of SO₂ along the coastal areas of PRD were in general lower than those of other areas. Summary of the monthly and annual averages of SO₂ at various stations are in Table 3.1c.

During the year, all monitoring stations in the Network were in compliance with the national hourly standard (0.50 mg/m³) and daily air quality standard (0.15 mg/m³) of SO₂. Details are shown in Table 3.1a and Table 3.1b.

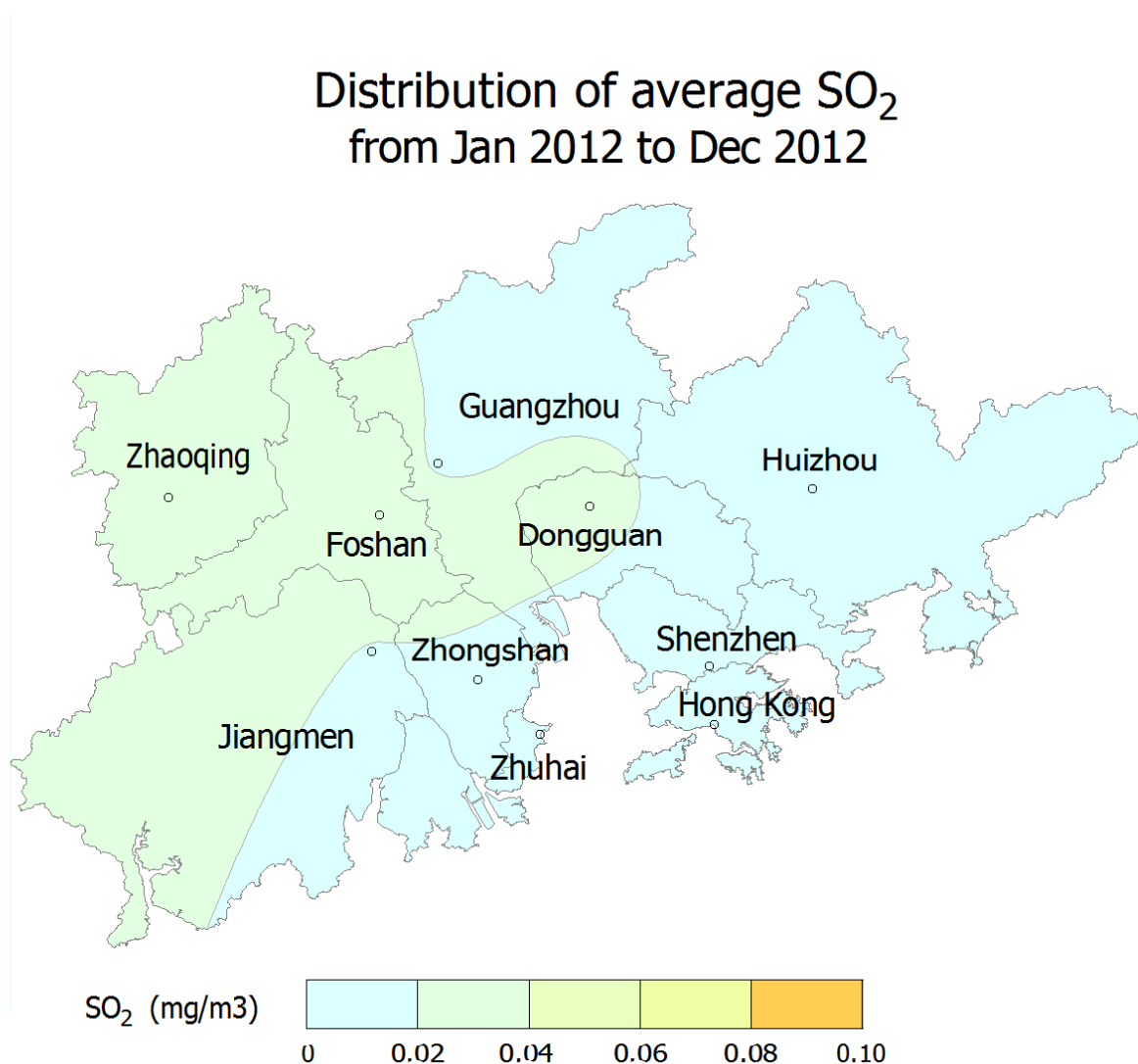


Figure 4 : Spatial distribution of average concentrations of Sulphur Dioxide (SO₂) in the Network

³ The current National Standards refer to Class 2 of the “National Ambient Air Quality Standards (GB 3095 – 1996 – revised version)” [NAAQS], which are applicable to residential, mixed commercial/residential, cultural, industrial and village areas. The Standards have been updated (GB 3095 – 2012) in 2012 and the new Standards will come into operation from 2016.

Table 3.1a : The monthly maxima and minima of hourly averages of Sulphur Dioxide**[Class 2 NAAQS (Hourly) : 0.50 mg/m³]**

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Hours	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.064	0.112	0.124	0.084	0.078	0.107	0.069	0.102	0.078	0.099	0.082	0.080	0	0.00%
	Min	0.000	0.001	0.003	0.001	0.000	0.000	0.001	0.004	0.002	0.003	0.004	0.003		
Wanqingsha ⁴ (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--		
Tianhu (Guangzhou)	Max	0.042	0.060	0.082	0.048	0.049	0.060	0.058	0.047	0.057	0.063	0.042	0.043	0	0.00%
	Min	0.003	0.004	0.003	0.003	0.003	0.002	0.004	0.003	0.004	0.006	0.006	0.006		
Liyuan (Shenzhen)	Max	0.033	0.021	0.054	0.041	0.032	0.074	0.049	0.052	0.033	0.058	0.031	0.041	0	0.00%
	Min	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001		
Tangjia (Zhuhai)	Max	0.069	0.067	0.042	0.130	0.041	0.043	0.050	0.071	0.064	0.067	0.070	0.058	0	0.00%
	Min	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.003	0.004	0.006	0.005	0.006		
Jinjuzui (Foshan)	Max	0.141	0.130	0.154	0.084	0.088	0.080	0.088	0.073	0.112	0.115	0.113	0.104	0	0.00%
	Min	0.009	0.010	0.012	0.008	0.010	0.011	0.011	0.012	0.002	0.003	0.003	0.006		
Huijingcheng (Foshan)	Max	0.102	0.146	0.209	0.180	0.112	0.125	0.154	0.160	0.127	0.183	0.197	0.198	0	0.00%
	Min	0.008	0.015	0.012	0.010	0.009	0.008	0.009	0.010	0.009	0.009	0.010	0.009		
Donghu (Jiangmen)	Max	0.056	0.099	0.124	0.171	0.064	0.044	0.058	0.052	0.124	0.154	0.171	0.109	0	0.00%
	Min	0.003	0.006	0.006	0.002	0.001	0.002	0.002	0.003	0.005	0.004	0.004	0.006		
Chengzhong (Zhaoqing)	Max	0.182	0.186	0.182	0.234	0.128	0.167	0.176	0.168	0.114	0.237	0.212	0.233	0	0.00%
	Min	0.007	0.009	0.003	0.002	0.001	0.002	0.004	0.003	0.002	0.004	0.004	0.006		
Xiapu (Huizhou)	Max	0.034	0.059	0.080	0.081	0.060	0.073	0.043	0.086	0.042	0.043	0.032	0.044	0	0.00%
	Min	0.004	0.004	0.005	0.005	0.003	0.004	0.005	0.005	0.006	0.006	0.006	0.007		
Jinguowan (Huizhou)	Max	0.024	0.037	0.024	0.055	0.016	0.041	0.034	0.039	0.029	0.041	0.034	0.041	0	0.00%
	Min	0.001	0.000	0.003	0.003	0.004	0.005	0.006	0.009	0.007	0.009	0.009	0.005		
Nanchengyuanling (Dongguan)	Max	0.139	0.102	0.168	0.119	0.092	0.121	0.198	0.204	0.159	0.151	0.075	0.126	0	0.00%
	Min	0.007	0.010	0.009	0.008	0.009	0.008	0.009	0.009	0.005	0.007	0.006	0.008		
Zimaling Park (Zhongshan)	Max	0.071	0.168	0.109	0.101	0.044	0.051	0.080	0.081	0.118	0.101	0.115	0.103	0	0.00%
	Min	0.004	0.004	0.004	0.004	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.004		
Tsuen Wan (HKSAR)	Max	0.074	0.140	0.098	0.087	0.078	0.063	0.083	0.116	0.088	0.087	0.054	0.086	0	0.00%
	Min	0.007	0.007	0.005	0.008	0.003	0.004	0.004	0.006	0.007	0.008	0.005	0.004		
Tap Mun (HKSAR)	Max	0.030	0.036	0.082	0.061	0.021	0.037	0.034	0.054	0.031	0.051	0.031	0.046	0	0.00%
	Min	0.008	0.008	0.006	0.000	0.002	0.003	0.004	0.006	0.005	0.008	0.008	0.009		
Tung Chung (HKSAR)	Max	0.061	0.055	0.087	0.081	0.039	0.089	0.073	0.099	0.046	0.084	0.041	0.049	0	0.00%
	Min	0.005	0.004	0.006	0.006	0.007	0.006	0.006	0.007	0.007	0.009	0.006	0.005		

Table 3.1b : The monthly maxima and minima of daily averages of Sulphur Dioxide**[Class 2 NAAQS (Daily) : 0.15 mg/m³]**

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Days	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.032	0.040	0.038	0.037	0.032	0.031	0.029	0.037	0.029	0.037	0.035	0.036	0	0.00%
	Min	0.001	0.004	0.004	0.005	0.003	0.004	0.009	0.010	0.006	0.004	0.006	0.007		
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--		
Tianhu (Guangzhou)	Max	0.026	0.034	0.039	0.025	0.026	0.029	0.022	0.025	0.023	0.041	0.024	0.032	0	0.00%
	Min	0.005	0.006	0.005	0.004	0.006	0.005	0.005	0.007	0.006	0.008	0.008	0.007		
Liyuan (Shenzhen)	Max	0.013	0.015	0.012	0.019	0.011	0.024	0.015	0.023	0.016	0.018	0.015	0.020	0	0.00%
	Min	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.004	0.002	0.002		
Tangjia (Zhuhai)	Max	0.052	0.023	0.013	0.043	0.017	0.016	0.022	0.032	0.024	0.022	0.040	0.029	0	0.00%
	Min	0.001	0.001	0.001	0.002	0.002	0.006	0.004	0.006	0.007	0.009	0.009	0.013		
Jinjuzui (Foshan)	Max	0.059	0.068	0.074	0.043	0.039	0.045	0.040	0.040	0.049	0.053	0.051	0.060	0	0.00%
	Min	0.011	0.012	0.016	0.018	0.013	0.014	0.013	0.015	0.010	0.011	0.010	0.013		
Huijingcheng (Foshan)	Max	0.058	0.082	0.097	0.067	0.045	0.049	0.075	0.075	0.054	0.079	0.090	0.111	0	0.00%
	Min	0.011	0.024	0.022	0.022	0.018	0.015	0.013	0.022	0.017	0.015	0.016	0.025		
Donghu (Jiangmen)	Max	0.036	0.057	0.047	0.035	0.026	0.022	0.026	0.021	0.056	0.062	0.063	0.066	0	0.00%
	Min	0.006	0.008	0.008	0.009	0.005	0.003	0.004	0.005	0.012	0.014	0.012	0.012		
Chengzhong (Zhaoqing)	Max	0.075	0.085	0.095	0.070	0.038	0.048	0.047	0.045	0.059	0.074	0.085	0.080	1	0.28%
	Min	0.008	0.010	0.013	0.009	0.008	0.003	0.006	0.006	0.010	0.008	0.010	0.015		
Xiapu (Huizhou)	Max	0.021	0.025	0.025	0.029	0.022	0.025	0.020	0.032	0.024	0.026	0.019	0.027	0	0.00%
	Min	0.005	0.007	0.009	0.008	0.006	0.007	0.007	0.006	0.007	0.009	0.006	0.008		
Jinguowan (Huizhou)	Max	0.019	0.027	0.020	0.026	0.009	0.013	0.014	0.020	0.019	0.025	0.018	0.029	0	0.00%
	Min	0.007	0.007	0.004	0.004	0.004	0.005	0.006	0.009	0.009	0.011	0.010	0.009		
Nanchengyuanling (Dongguan)	Max	0.047	0.048	0.067	0.058	0.035	0.050	0.059	0.078	0.052	0.046	0.036	0.044	0	0.00%
	Min	0.009	0.013	0.013	0.011	0.011	0.010	0.011	0.014	0.012	0.011	0.010	0.014		
Zimaling Park (Zhongshan)	Max	0.029	0.069	0.059	0.034	0.010	0.016	0.042	0.032	0.046	0.040	0.059	0.046	0	0.00%
	Min	0.006	0.006	0.006	0.004	0.003	0.002	0.002	0.002	0.004	0.006	0.004	0.007		
Tsuen Wan (HKSAR)	Max	0.037	0.072	0.043	0.042	0.035	0.029	0.032	0.047	0.026	0.028	0.027	0.029	0	0.00%
	Min	0.008	0.008	0.008	0.009	0.004	0.005	0.005	0.007	0.007	0.009	0.008	0.008		
Tap Mun (HKSAR)	Max	0.021	0.023	0.022	0.016	0.009	0.013	0.018	0.029	0.019	0.022	0.022	0.028	0	0.00%
	Min	0.010	0.010	0.011	0.001	0.003	0.004	0.005	0.008	0.007	0.010	0.010	0.010		
Tung Chung (HKSAR)	Max	0.025	0.023	0.039	0.034	0.019	0.030	0.027	0.042	0.022	0.026	0.024	0.031	0	0.00%
	Min	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.011	0.012	0.007	0.008		

⁴ Owing to the extensive renovation work at the Guangzhou Nansha Wanqingsha monitoring station, the station was temporarily suspended from operation in 2012.

Table 3.1c : The monthly and annual averages of Sulphur Dioxide**[Class 2 NAAQS (Annual) : 0.06 mg/m³]**

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.012	0.019	0.018	0.018	0.018	0.013	0.018	0.022	0.017	0.023	0.019	0.018	0.018
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.012	0.014	0.014	0.011	0.011	0.010	0.013	0.012	0.013	0.021	0.015	0.017	0.014
Liyuan (Shenzhen)	0.006	0.006	0.005	0.005	0.004	0.006	0.007	0.010	0.007	0.011	0.007	0.009	0.007
Tangjia (Zhuhai)	0.020	0.009	0.007	0.009	0.009	0.009	0.009	0.014	0.015	0.015	0.016	0.019	0.012
Jinjuzui (Foshan)	0.025	0.035	0.035	0.029	0.025	0.026	0.024	0.024	0.021	0.027	0.026	0.032	0.027
Huijingcheng (Foshan)	0.027	0.044	0.044	0.038	0.030	0.029	0.028	0.045	0.033	0.036	0.040	0.046	0.037
Donghu (Jiangmen)	0.012	0.023	0.018	0.017	0.013	0.009	0.009	0.012	0.020	0.029	0.028	0.033	0.019
Chengzhong (Zhaoqing)	0.024	0.038	0.048	0.036	0.020	0.022	0.022	0.019	0.026	0.044	0.045	0.044	0.032
Xiapu (Huizhou)	0.011	0.013	0.014	0.013	0.012	0.012	0.012	0.012	0.012	0.015	0.012	0.015	0.013
Jinguowan (Huizhou)	0.011	0.013	0.010	0.008	0.006	0.007	0.008	0.013	0.013	0.015	0.014	0.016	0.011
Nanchengyuanling (Dongguan)	0.024	0.025	0.028	0.022	0.019	0.023	0.021	0.039	0.023	0.025	0.021	0.026	0.025
Zimaling Park (Zhongshan)	0.016	0.030	0.020	0.011	0.005	0.004	0.007	0.013	0.017	0.015	0.019	0.025	0.015
Tsuen Wan (HKSAR)	0.018	0.018	0.016	0.023	0.016	0.014	0.015	0.024	0.013	0.016	0.015	0.016	0.017
Tap Mun (HKSAR)	0.015	0.013	0.013	0.008	0.005	0.006	0.008	0.014	0.012	0.014	0.014	0.015	0.011
Tung Chung (HKSAR)	0.015	0.014	0.014	0.015	0.012	0.011	0.011	0.018	0.016	0.018	0.014	0.015	0.014

Remark : All concentration units are in milligrams per cubic metre.

3.2 Nitrogen Dioxide (NO₂)

Nitrogen Dioxide (NO₂) is mainly formed from oxidization of nitric oxide (NO) emitted in the process of combustion. Its major emission sources include power plants, industrial combustion plants, vehicles, vessels, etc. Apart from its impact on human respiratory system, NO₂ can also be oxidized in the air to form nitrate, which has significant impact on the levels of particulates, acid rain and visibility in the region.

The annual averages of NO₂ at various monitoring stations in the Network ranged from 0.012 mg/m³ to 0.067 mg/m³ in 2012, all were in compliance with the national annual air quality standard (0.08 mg/m³). During the year, 5 monitoring stations in the Network had recorded exceedance of the national hourly standard (0.24 mg/m³) and also 5 monitoring stations had recorded exceedance of the national daily air quality standard (0.12 mg/m³) of NO₂. Details are shown on Figures 5 and Tables 3.2a to 3.2c.

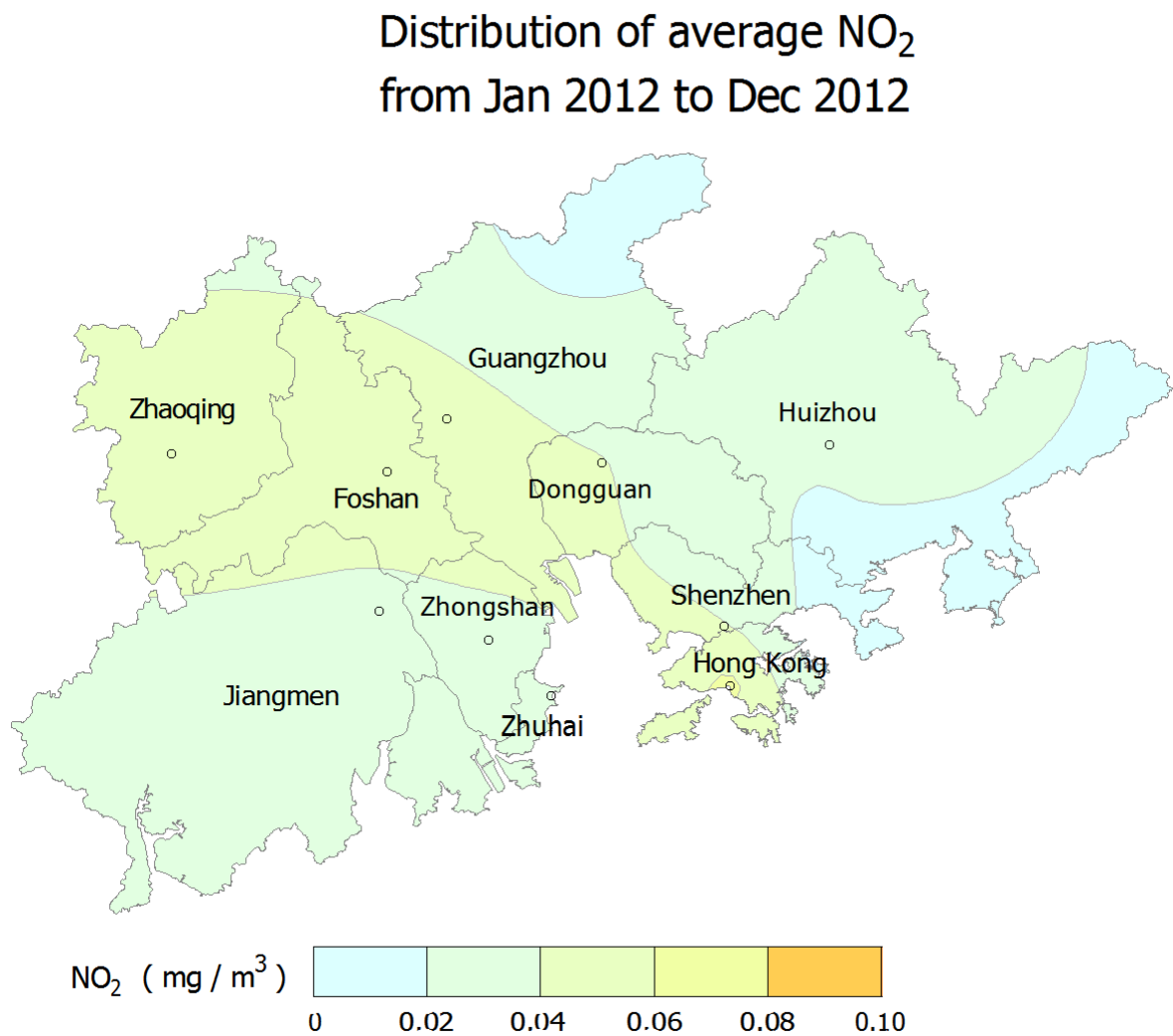


Figure 5 : Spatial distribution of average concentrations of Nitrogen Dioxide (NO₂) in the Network

Table 3.2a : The monthly maxima and minima of hourly averages of Nitrogen Dioxide

[Class 2 NAAQS (Hourly) : 0.24 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Hours	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.094	0.131	0.187	0.120	0.141	0.144	0.168	0.144	0.155	0.237	0.179	0.184	0	0.00%
	Min	0.003	0.002	0.015	0.012	0.010	0.007	0.007	0.004	0.000	0.015	0.017	0.017		
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--		
Tianhu (Guangzhou)	Max	0.054	0.057	0.093	0.071	0.058	0.074	0.070	0.049	0.050	0.054	0.064	0.070	0	0.00%
	Min	0.005	0.006	0.003	0.003	0.003	0.000	0.001	0.000	0.000	0.000	0.000	0.000		
Liyuan (Shenzhen)	Max	0.147	0.111	0.143	0.222	0.081	0.133	0.168	0.233	0.176	0.129	0.141	0.170	0	0.00%
	Min	0.006	0.009	0.009	0.004	0.003	0.004	0.001	0.004	0.006	0.006	0.006	0.000		
Tangjia (Zhuhai)	Max	0.118	0.114	0.116	0.121	0.097	0.095	0.080	0.099	0.124	0.091	0.122	0.158	0	0.00%
	Min	0.002	0.003	0.000	0.000	0.000	0.002	0.001	0.003	0.004	0.017	0.019	0.033		
Jinjuzui (Foshan)	Max	0.156	0.154	0.242	0.135	0.100	0.102	0.095	0.113	0.125	0.162	0.179	0.256	3	0.04%
	Min	0.006	0.012	0.014	0.004	0.007	0.005	0.007	0.007	0.007	0.008	0.008	0.016		
Huijingcheng (Foshan)	Max	0.154	0.211	0.255	0.205	0.137	0.115	0.253	0.158	0.219	0.254	0.220	0.233	5	0.06%
	Min	0.008	0.012	0.006	0.012	0.009	0.011	0.009	0.015	0.015	0.017	0.024	0.009		
Donghu (Jiangmen)	Max	0.086	0.099	0.124	0.097	0.077	0.071	0.067	0.077	0.113	0.113	0.167	0.184	0	0.00%
	Min	0.010	0.010	0.008	0.010	0.006	0.006	0.005	0.008	0.009	0.010	0.008	0.010		
Chengzhong (Zhaoqing)	Max	0.145	0.166	0.166	0.118	0.079	0.092	0.098	0.103	0.100	0.145	0.176	0.194	0	0.00%
	Min	0.013	0.017	0.006	0.003	0.002	0.005	0.001	0.003	0.006	0.017	0.014	0.017		
Xiapu (Huizhou)	Max	0.116	0.107	0.166	0.135	0.096	0.095	0.075	0.094	0.107	0.164	0.139	0.143	0	0.00%
	Min	0.004	0.005	0.000	0.012	0.012	0.007	0.003	0.009	0.008	0.009	0.006	0.015		
Jinguowan (Huizhou)	Max	0.048	0.056	0.067	0.063	0.064	0.061	0.051	0.053	0.050	0.074	0.052	0.082	0	0.00%
	Min	0.004	0.004	0.003	0.003	0.002	0.001	0.000	0.001	0.000	0.007	0.008	0.005		
Nanchengyuanling (Dongguan)	Max	0.153	0.251	0.196	0.150	0.103	0.145	0.134	0.141	0.136	0.208	0.178	0.153	1	0.01%
	Min	0.006	0.015	0.009	0.008	0.005	0.005	0.003	0.003	0.000	0.004	0.011	0.003		
Zimaling Park (Zhongshan)	Max	0.110	0.164	0.239	0.104	0.076	0.069	0.070	0.109	0.116	0.125	0.136	0.173	0	0.00%
	Min	0.013	0.016	0.009	0.006	0.004	0.000	0.000	0.000	0.000	0.000	0.003	0.013		
Tsuen Wan (HKSAR)	Max	0.175	0.192	0.158	0.195	0.161	0.144	0.202	0.275	0.189	0.179	0.200	0.153	1	0.01%
	Min	0.013	0.015	0.016	0.017	0.014	0.015	0.008	0.006	0.016	0.017	0.020	0.020		
Tap Mun (HKSAR)	Max	0.092	0.042	0.057	0.085	0.040	0.055	0.054	0.088	0.030	0.050	0.043	0.058	0	0.00%
	Min	0.004	0.005	0.003	0.004	0.002	0.002	0.002	0.001	0.001	0.003	0.003	0.004		
Tung Chung (HKSAR)	Max	0.184	0.166	0.258	0.221	0.099	0.135	0.137	0.178	0.189	0.187	0.145	0.196	1	0.01%
	Min	0.012	0.011	0.007	0.005	0.007	0.005	0.005	0.006	0.009	0.009	0.005	0.010		

Table 3.2b : The monthly maxima and minima of daily averages of Nitrogen Dioxide

[Class 2 NAAQS (Daily) : 0.12 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Days	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.056	0.079	0.099	0.071	0.077	0.055	0.077	0.080	0.078	0.114	0.095	0.118	0	0.00%
	Min	0.009	0.019	0.026	0.024	0.025	0.022	0.020	0.036	0.024	0.039	0.033	0.033		
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--		
Tianhu (Guangzhou)	Max	0.030	0.035	0.051	0.028	0.025	0.031	0.025	0.025	0.023	0.025	0.020	0.029	0	0.00%
	Min	0.006	0.008	0.007	0.004	0.005	0.001	0.002	0.002	0.000	0.003	0.003	0.000		
Liyuan (Shenzhen)	Max	0.074	0.068	0.065	0.108	0.042	0.057	0.079	0.098	0.067	0.062	0.071	0.120	0	0.00%
	Min	0.019	0.030	0.025	0.021	0.017	0.016	0.016	0.020	0.016	0.021	0.023	0.028		
Tangjia (Zhuhai)	Max	0.084	0.071	0.078	0.067	0.056	0.037	0.037	0.048	0.050	0.053	0.073	0.103	0	0.00%
	Min	0.013	0.018	0.023	0.011	0.004	0.005	0.007	0.009	0.018	0.026	0.028	0.048		
Jinjuzui (Foshan)	Max	0.096	0.106	0.126	0.075	0.053	0.060	0.052	0.067	0.076	0.079	0.109	0.104	3	0.87%
	Min	0.023	0.030	0.028	0.016	0.012	0.017	0.016	0.018	0.021	0.037	0.029	0.027		
Huijingcheng (Foshan)	Max	0.098	0.119	0.166	0.114	0.076	0.061	0.140	0.085	0.090	0.144	0.135	0.151	5	1.42%
	Min	0.022	0.033	0.040	0.027	0.022	0.023	0.022	0.031	0.035	0.042	0.039	0.035		
Donghu (Jiangmen)	Max	0.055	0.032	0.047	0.049	0.049	0.041	0.044	0.040	0.068	0.064	0.090	0.090	0	0.00%
	Min	0.011	0.013	0.013	0.015	0.012	0.010	0.012	0.015	0.021	0.023	0.022	0.029		
Chengzhong (Zhaoqing)	Max	0.082	0.128	0.098	0.073	0.043	0.061	0.044	0.046	0.066	0.083	0.109	0.113	1	0.30%
	Min	0.021	0.029	0.019	0.017	0.014	0.019	0.011	0.013	0.020	0.028	0.025	0.026		
Xiapu (Huizhou)	Max	0.045	0.068	0.063	0.067	0.049	0.040	0.035	0.050	0.041	0.055	0.057	0.071	0	0.00%
	Min	0.013	0.024	0.021	0.027	0.024	0.018	0.012	0.022	0.018	0.024	0.024	0.027		
Jinguowan (Huizhou)	Max	0.030	0.036	0.029	0.023	0.023	0.026	0.024	0.027	0.020	0.035	0.033	0.031	0	0.00%
	Min	0.006	0.013	0.012	0.007	0.006	0.003	0.003	0.006	0.007	0.010	0.012	0.014		
Nanchengyuanling (Dongguan)	Max	0.074	0.084	0.094	0.075	0.050	0.053	0.055	0.073	0.060	0.075	0.080	0.086	0	0.00%
	Min	0.013	0.026	0.029	0.021	0.020	0.017	0.012	0.017	0.013	0.018	0.018	0.014		
Zimaling Park (Zhongshan)	Max	0.052	0.113	0.114	0.072	0.042	0.034	0.028	0.048	0.059	0.061	0.082	0.110	0	0.00%
	Min	0.020	0.029	0.019	0.011	0.011	0.003	0.004	0.003	0.010	0.018	0.011	0.027		
Tsuen Wan (HKSAR)	Max	0.092	0.126	0.111	0.127	0.086	0.092	0.101	0.135	0.099	0.103	0.094	0.098	5	1.42%
	Min	0.036	0.035	0.043	0.050	0.044	0.048	0.031	0.036	0.033	0.051	0.055	0.046		
Tap Mun (HKSAR)	Max	0.032	0.021	0.032	0.043	0.021	0.026	0.032	0.042	0.015	0.020	0.019	0.022	0	0.00%
	Min	0.006	0.009	0.008	0.005	0.004	0.004	0.003	0.005	0.004	0.004	0.007	0.009		
Tung Chung (HKSAR)	Max	0.095	0.089	0.135	0.133	0.065	0.057	0.075	0.101	0.095	0.091	0.078	0.092	2	0.56%
	Min	0.033	0.029	0.012	0.010	0.014	0.010	0.008	0.014	0.019	0.029	0.021	0.031		

Table 3.2c : The monthly and annual averages of Nitrogen Dioxide**[Class 2 NAAQS (Annual) : 0.08 mg/m³]**

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.031	0.041	0.047	0.046	0.050	0.036	0.037	0.056	0.049	0.067	0.059	0.065	0.048
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.014	0.018	0.021	0.013	0.012	0.011	0.011	0.007	0.007	0.011	0.009	0.010	0.012
Liyuan (Shenzhen)	0.045	0.043	0.042	0.043	0.029	0.032	0.033	0.050	0.035	0.036	0.045	0.053	0.041
Tangjia (Zhuhai)	0.039	0.038	0.037	0.037	0.026	0.018	0.018	0.024	0.035	0.039	0.051	0.068	0.036
Jinjuzui (Foshan)	0.050	0.056	0.059	0.048	0.035	0.033	0.029	0.037	0.042	0.051	0.060	0.066	0.047
Huijingcheng (Foshan)	0.048	0.065	0.067	0.066	0.050	0.041	0.044	0.056	0.059	0.068	0.075	0.076	0.060
Donghu (Jiangmen)	0.021	0.019	0.025	0.029	0.025	0.023	0.022	0.024	0.034	0.038	0.054	0.053	0.031
Chengzhong (Zhaoqing)	0.044	0.056	0.047	0.047	0.029	0.029	0.026	0.032	0.036	0.057	0.062	0.063	0.044
Xiapu (Huizhou)	0.032	0.038	0.042	0.040	0.032	0.029	0.023	0.033	0.028	0.036	0.041	0.044	0.035
Jinguowan (Huizhou)	0.020	0.021	0.019	0.014	0.010	0.009	0.012	0.015	0.012	0.016	0.021	0.021	0.016
Nanchengyuanling (Dongguan)	0.040	0.048	0.055	0.045	0.033	0.033	0.030	0.040	0.031	0.040	0.045	0.048	0.041
Zimaling Park (Zhongshan)	0.037	0.058	0.050	0.035	0.027	0.016	0.012	0.023	0.031	0.032	0.049	0.062	0.036
Tsuen Wan (HKSAR)	0.067	0.067	0.067	0.071	0.057	0.065	0.051	0.074	0.060	0.079	0.071	0.069	0.067
Tap Mun (HKSAR)	0.017	0.015	0.014	0.014	0.008	0.010	0.010	0.018	0.008	0.008	0.012	0.015	0.013
Tung Chung (HKSAR)	0.065	0.055	0.054	0.048	0.034	0.031	0.027	0.051	0.045	0.054	0.050	0.057	0.048

Remark : All concentration units are in milligrams per cubic metre.

3.3 Ozone (O₃)

Ozone (O₃) is not directly emitted from emission sources. It is formed by the photochemical reaction of oxygen, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the air under sunlight, and is one of the main components of photochemical smog. Ozone can cause irritation to the eyes, nose and throat. At elevated levels, it can increase a person's susceptibility to respiratory diseases and aggravate pre-existing respiratory diseases such as asthma.

The precursors of O₃ (NO_x and VOCs) mainly originate from pollution sources in urban areas. However, as it usually takes several hours for O₃ to be formed and rise to its peak level, O₃ and its precursors can be transported to other areas downwind of their sources during this period. The concentrations of O₃ in rural areas are therefore often higher than those in the urban areas. In 2012, the annual averages of O₃ recorded by the Network ranged from 0.035 mg/m³ to 0.079 mg/m³ with higher average values being recorded in rural areas such as Tianhu of Guangzhou, Tap Mun of Hong Kong and Jinguowan of Huizhou, similar to the situation in previous years. During the year, all monitoring stations in the Network had recorded exceedance of the national hourly standard (0.2 mg/m³) of O₃. Details are shown on Figures 6 and Tables 3.3a to 3.3c.

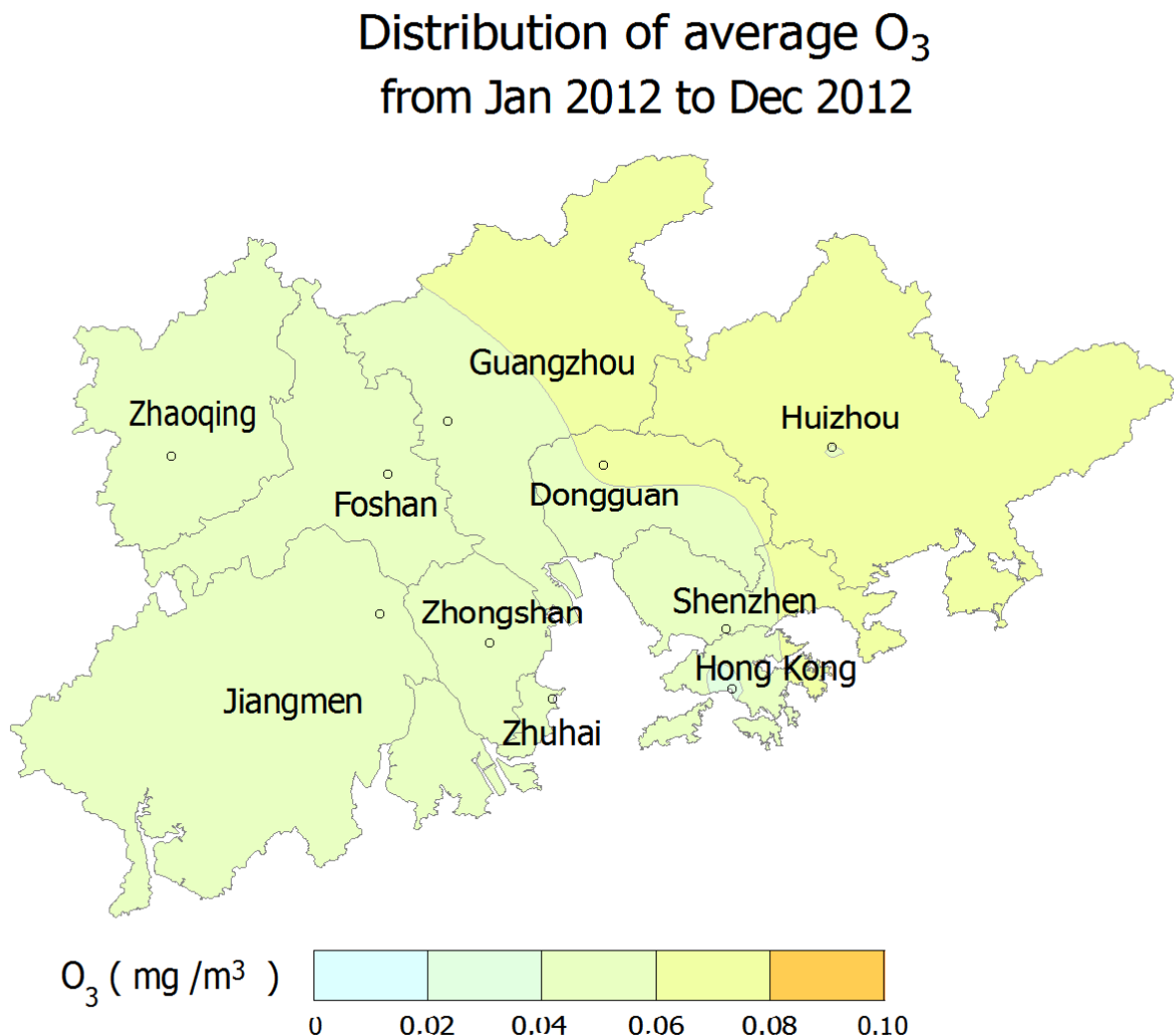


Figure 6 : Spatial distribution of average concentrations of Ozone (O₃) in the Network

Table 3.3a : The monthly maxima and minima of hourly averages of Ozone

[Class 2 NAAQS (Hourly) : 0.20mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Hours	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.139	0.155	0.273	0.247	0.346	0.354	0.364	0.324	0.252	0.358	0.236	0.194	224	2.61%
	Min	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.003	0.005	0.001	0.000	0.000		
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--		
Tianhu (Guangzhou)	Max	0.127	0.151	0.208	0.247	0.210	0.269	0.250	0.243	0.205	0.284	0.171	0.190	113	1.38%
	Min	0.003	0.003	0.002	0.002	0.003	0.004	0.003	0.003	0.003	0.015	0.004	0.003		
Liyuan (Shenzhen)	Max	0.168	0.143	0.195	0.213	0.190	0.221	0.299	0.304	0.212	0.224	0.188	0.130	30	0.35%
	Min	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000		
Tangjia (Zhuhai)	Max	0.197	0.161	0.185	0.154	0.257	0.217	0.300	0.306	0.256	0.247	0.167	0.135	113	1.40%
	Min	0.000	0.000	0.000	0.000	0.006	0.006	0.000	0.016	0.013	0.018	0.016	0.004		
Jinjuzui (Foshan)	Max	0.140	0.162	0.286	0.233	0.256	0.264	0.333	0.313	0.299	0.364	0.210	0.174	252	2.99%
	Min	0.001	0.001	0.001	0.002	0.005	0.002	0.002	0.002	0.002	0.006	0.000	0.005		
Huijingcheng (Foshan)	Max	0.116	0.144	0.245	0.246	0.232	0.263	0.264	0.297	0.307	0.314	0.232	0.175	201	2.39%
	Min	0.002	0.000	0.003	0.004	0.003	0.003	0.003	0.004	0.003	0.005	0.004	0.003		
Donghu (Jiangmen)	Max	0.139	0.180	0.264	0.200	0.335	0.261	0.222	0.275	0.276	0.313	0.225	0.152	198	2.33%
	Min	0.002	0.003	0.003	0.002	0.003	0.003	0.001	0.004	0.002	0.004	0.004	0.003		
Chengzhong (Zhaoqing)	Max	0.114	0.132	0.223	0.300	0.256	0.255	0.224	0.220	0.241	0.325	0.206	0.108	116	1.40%
	Min	0.002	0.003	0.005	0.003	0.002	0.005	0.003	0.007	0.003	0.001	0.000	0.000		
Xiapu (Huizhou)	Max	0.123	0.101	0.209	0.251	0.267	0.202	0.275	0.267	0.261	0.270	0.203	0.132	86	1.01%
	Min	0.001	0.003	0.003	0.002	0.002	0.003	0.002	0.004	0.003	0.003	0.001	0.001		
Jinguowan (Huizhou)	Max	0.138	0.137	0.191	0.231	0.177	0.224	0.279	0.219	0.222	0.294	0.177	0.135	65	0.80%
	Min	0.002	0.003	0.001	0.003	0.006	0.006	0.005	0.008	0.006	0.010	0.006	0.006		
Nanchengyuanling (Dongguan)	Max	0.184	0.220	0.247	0.272	0.291	0.354	0.366	0.285	0.362	0.382	0.246	0.231	332	3.98%
	Min	0.004	0.001	0.001	0.002	0.002	0.003	0.002	0.002	0.002	0.004	0.002	0.002		
Zimaling Park (Zhongshan)	Max	0.119	0.151	0.222	0.290	0.290	0.277	0.282	0.327	0.246	0.286	0.213	0.145	178	2.17%
	Min	0.005	0.005	0.004	0.009	0.001	0.001	0.003	0.006	0.002	0.001	0.001	0.001		
Tsuen Wan (HKSAR)	Max	0.102	0.080	0.143	0.173	0.120	0.201	0.353	0.299	0.250	0.183	0.151	0.083	19	0.22%
	Min	0.002	0.000	0.003	0.002	0.003	0.003	0.003	0.003	0.003	0.005	0.001	0.001		
Tap Mun (HKSAR)	Max	0.158	0.146	0.177	0.248	0.196	0.258	0.354	0.333	0.212	0.232	0.198	0.152	128	1.53%
	Min	0.003	0.005	0.003	0.002	0.003	0.004	0.005	0.004	0.005	0.018	0.013	0.006		
Tung Chung (HKSAR)	Max	0.113	0.111	0.178	0.283	0.292	0.307	0.405	0.419	0.286	0.316	0.289	0.111	127	1.48%
	Min	0.002	0.003	0.004	0.006	0.004	0.004	0.003	0.003	0.003	0.004	0.002	0.002		

Table 3.3b : The monthly maxima and minima of daily averages of Ozone

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Luhu Park (Guangzhou)	Max	0.066	0.064	0.084	0.085	0.124	0.106	0.107	0.101	0.116	0.151	0.076	0.047
	Min	0.001	0.001	0.001	0.004	0.008	0.007	0.007	0.020	0.018	0.015	0.002	0.002
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	Max	0.094	0.093	0.191	0.141	0.128	0.117	0.130	0.135	0.164	0.191	0.126	0.106
	Min	0.009	0.012	0.009	0.043	0.049	0.032	0.038	0.046	0.047	0.066	0.024	0.012
Liyuan (Shenzhen)	Max	0.087	0.086	0.110	0.095	0.099	0.084	0.087	0.101	0.113	0.143	0.094	0.071
	Min	0.003	0.001	0.002	0.005	0.009	0.010	0.003	0.007	0.010	0.030	0.006	0.011
Tangjia (Zhuhai)	Max	0.077	0.066	0.070	0.090	0.105	0.071	0.139	0.172	0.133	0.153	0.084	0.061
	Min	0.002	0.001	0.003	0.009	0.024	0.031	0.015	0.043	0.035	0.047	0.039	0.024
Jinjuzui (Foshan)	Max	0.056	0.064	0.108	0.085	0.093	0.115	0.114	0.109	0.145	0.176	0.080	0.053
	Min	0.002	0.003	0.003	0.008	0.018	0.015	0.006	0.014	0.005	0.030	0.008	0.007
Huijingcheng (Foshan)	Max	0.047	0.053	0.096	0.092	0.108	0.100	0.094	0.103	0.117	0.158	0.087	0.050
	Min	0.003	0.004	0.004	0.006	0.012	0.010	0.007	0.020	0.007	0.016	0.004	0.004
Donghu (Jiangmen)	Max	0.054	0.071	0.089	0.093	0.130	0.095	0.108	0.122	0.138	0.166	0.091	0.052
	Min	0.005	0.005	0.005	0.011	0.016	0.021	0.011	0.021	0.010	0.035	0.006	0.006
Chengzhong (Zhaoqing)	Max	0.057	0.077	0.109	0.106	0.113	0.112	0.091	0.084	0.140	0.152	0.092	0.060
	Min	0.004	0.007	0.009	0.022	0.024	0.016	0.011	0.025	0.012	0.009	0.001	0.001
Xiapu (Huizhou)	Max	0.068	0.062	0.104	0.110	0.129	0.104	0.119	0.121	0.146	0.158	0.117	0.080
	Min	0.004	0.013	0.013	0.018	0.035	0.028	0.017	0.024	0.029	0.055	0.005	0.006
Jinguowan (Huizhou)	Max	0.082	0.082	0.123	0.117	0.108	0.103	0.118	0.111	0.152	0.165	0.124	0.089
	Min	0.015	0.020	0.016	0.028	0.030	0.040	0.025	0.034	0.030	0.064	0.016	0.013
Nanchengyuanling (Dongguan)	Max	0.088	0.082	0.115	0.107	0.136	0.120	0.115	0.119	0.155	0.182	0.100	0.074
	Min	0.007	0.008	0.004	0.016	0.027	0.022	0.014	0.027	0.031	0.046	0.004	0.005
Zimaling Park (Zhongshan)	Max	0.052	0.073	0.111	0.134	0.112	0.095	0.135	0.142	0.114	0.138	0.084	0.048
	Min	0.007	0.007	0.007	0.027	0.027	0.032	0.012	0.020	0.013	0.037	0.002	0.002
Tsuen Wan (HKSAR)	Max	0.063	0.052	0.093	0.096	0.094	0.080	0.086	0.090	0.099	0.137	0.100	0.055
	Min	0.003	0.004	0.006	0.006	0.008	0.016	0.007	0.009	0.007	0.042	0.006	0.005
Tap Mun (HKSAR)	Max	0.117	0.098	0.145	0.137	0.141	0.124	0.107	0.165	0.166	0.206	0.137	0.105
	Min	0.017	0.015	0.019	0.023	0.031	0.044	0.028	0.020	0.027	0.073	0.033	0.038
Tung Chung (HKSAR)	Max	0.077	0.077	0.132	0.135	0.116	0.102	0.129	0.131	0.119	0.173	0.122	0.059
	Min	0.003	0.006	0.006	0.021	0.014	0.032	0.013	0.012	0.016	0.052	0.005	0.005

Table 3.3c : The monthly and annual averages of Ozone

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.022	0.019	0.024	0.029	0.054	0.052	0.050	0.062	0.060	0.085	0.032	0.020	0.043
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.052	0.056	0.073	0.080	0.083	0.073	0.071	0.089	0.094	0.138	0.078	0.063	0.079
Liyuan (Shenzhen)	0.029	0.030	0.048	0.041	0.045	0.041	0.021	0.044	0.053	0.095	0.045	0.032	0.044
Tangjia (Zhuhai)	0.025	0.026	0.031	0.037	0.050	0.049	0.056	0.087	0.074	0.094	0.057*	0.039	0.053
Jinjuzui (Foshan)	0.020	0.021	0.031	0.038	0.051	0.053	0.041	0.056	0.073	0.118	0.045	0.026	0.048
Huijingcheng (Foshan)	0.019	0.020	0.034	0.037	0.056	0.054	0.041	0.060	0.066	0.096	0.035	0.022	0.045
Donghu (Jiangmen)	0.023	0.025	0.034	0.041	0.055	0.049	0.033	0.064	0.067	0.105	0.042	0.025	0.047
Chengzhong (Zhaoqing)	0.027	0.030	0.043	0.045	0.061	0.050	0.041	0.057	0.076	0.099	0.037	0.020	0.048
Xiapu (Huizhou)	0.025	0.031	0.055	0.055	0.070	0.063	0.057	0.066	0.073	0.119	0.059	0.038	0.059
Jinguowan (Huizhou)	0.043	0.047	0.068	0.062	0.062	0.064	0.053	0.064	0.075	0.123	0.069	0.053	0.065
Nanchengyuanling (Dongguan)	0.041	0.037	0.048	0.054	0.076	0.069	0.055	0.072	0.086	0.120	0.055	0.034	0.062
Zimaling Park (Zhongshan)	0.016	0.028	0.045	0.065	0.056	0.056	0.049	0.072	0.057	0.097	0.040	0.021	0.050
Tsuen Wan (HKSAR)	0.020	0.021	0.037	0.034	0.033	0.032	0.020	0.037	0.042	0.078	0.043	0.026	0.035
Tap Mun (HKSAR)	0.054	0.057	0.070	0.076	0.082	0.077	0.047	0.078	0.091	0.143	0.077	0.067	0.077
Tung Chung (HKSAR)	0.021	0.031	0.049	0.058	0.053	0.059	0.038	0.061	0.055	0.102	0.050	0.029	0.051

Remarks :

1. All concentration units are in milligrams per cubic metre.
2. "*" denotes that the data capture rate does not meet the minimum requirements for determining a representative value.

3.4 Respirable Suspended Particulates (PM₁₀)

Respirable suspended particulates (PM₁₀ or RSP) in the atmosphere come from a great variety of emission sources, such as power plants, vehicles, vessels, cement and pottery manufacturing, fugitive dust etc, while some are products of oxidization of gaseous pollutants in the air (e.g. sulphate formed from oxidation of SO₂) or formed from photochemical reactions. PM₁₀ can penetrate deeply into human lungs and cause impact on human respiratory system. Furthermore, finer particles in PM₁₀ have significant effect on visibility.

In 2012, the annual averages of PM₁₀ at various monitoring stations in the Network ranged from 0.041 mg/m³ to 0.083 mg/m³. As shown in Figure 7, the average levels of PM₁₀ in the central to north-western part of PRD were relatively higher than those in the coastal areas in the south. During the year, all monitoring stations in the Network were in compliance with the national annual air quality standard (0.10 mg/m³) of PM₁₀ while 14 monitoring stations had recorded exceedance of the national daily standard (0.15mg/m³) of PM₁₀. Details are shown on Tables 3.4a to 3.4c.

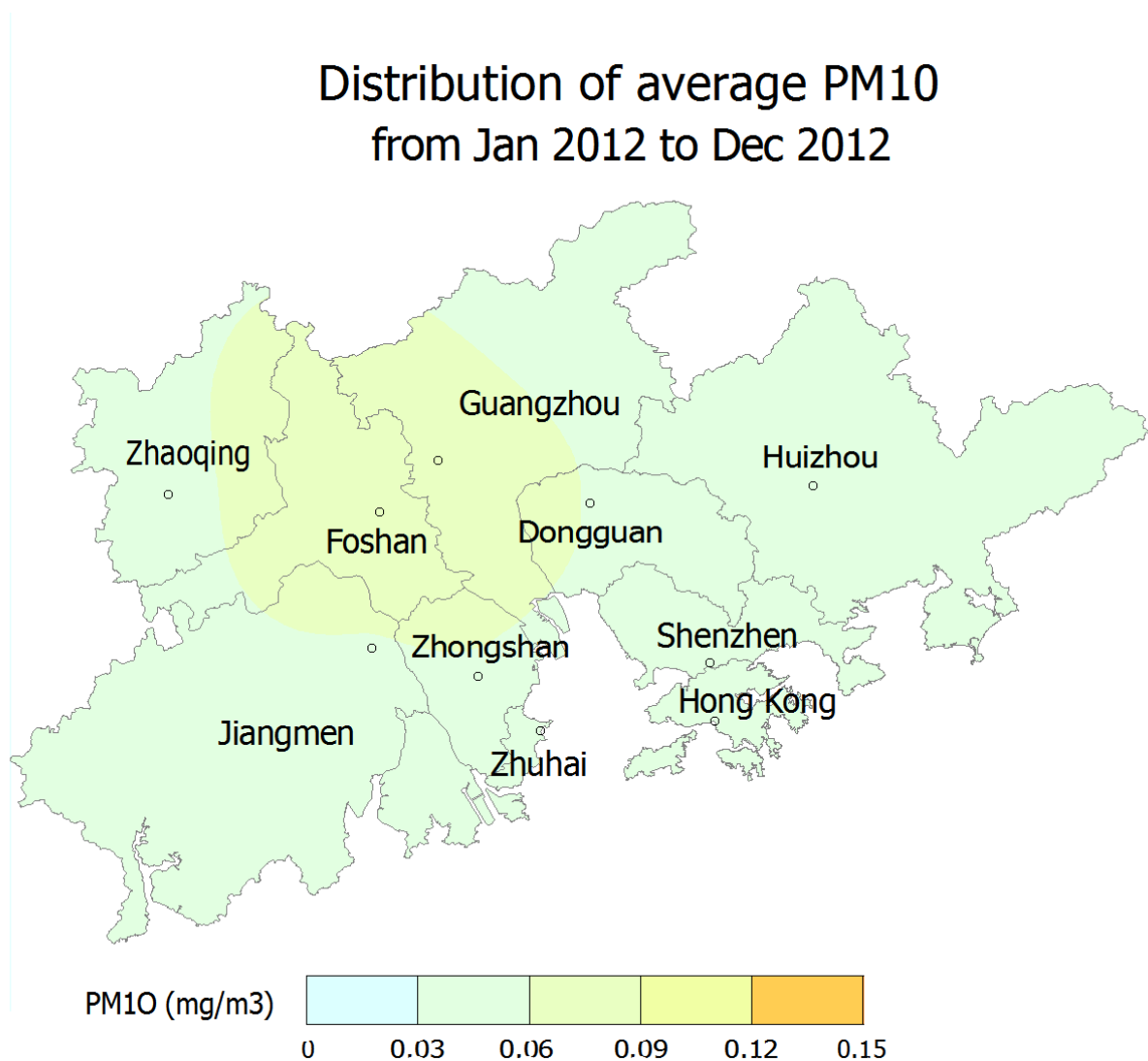


Figure 7 : Spatial distribution of average concentrations of Respirable Suspended Particulates (PM₁₀) in the Network

Table 3.4a : The monthly maxima and minima of hourly averages of Respirable Suspended Particulates

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Luhu Park (Guangzhou)	Max	0.213	0.224	0.360	0.219	0.194	0.178	0.138	0.159	0.206	0.289	0.241	0.239
	Min	0.017	0.016	0.025	0.024	0.033	0.024	0.020	0.026	0.020	0.003	0.002	0.000
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	Max	0.126	0.187	0.230	0.204	0.107	0.136	0.116	0.171	0.128	0.222	0.176	0.147
	Min	0.000	0.000	0.002	0.001	0.003	0.002	0.001	0.002	0.005	0.001	0.001	0.000
Liyuan (Shenzhen)	Max	0.179	0.187	0.235	0.192	0.096	0.111	0.205	0.183	0.147	0.178	0.192	0.223
	Min	0.001	0.002	0.000	0.000	0.001	0.001	0.002	0.006	0.004	0.008	0.006	0.007
Tangjia (Zhuhai)	Max	0.196	0.196	0.246	0.167	0.125	0.120	0.173	0.191	0.142	0.214	0.133	0.223
	Min	0.000	0.002	0.003	0.000	0.004	0.008	0.004	0.006	0.003	0.013	0.008	0.002
Jinjuzui (Foshan)	Max	0.236	0.297	0.448	0.246	0.121	0.158	0.175	0.180	0.205	0.262	0.338	0.372
	Min	0.001	0.006	0.004	0.000	0.001	0.003	0.002	0.002	0.005	0.010	0.008	0.003
Huijingcheng (Foshan)	Max	0.270	0.272	0.484	0.422	0.174	0.157	0.262	0.221	0.323	0.421	0.375	0.402
	Min	0.009	0.017	0.021	0.007	0.006	0.006	0.007	0.010	0.004	0.012	0.013	0.011
Donghu (Jiangmen)	Max	0.121	0.244	0.247	0.270	0.176	0.170	0.300	0.228	0.237	0.232	0.189	0.250
	Min	0.000	0.002	0.011	0.000	0.001	0.001	0.002	0.001	0.004	0.004	0.006	0.001
Chengzhong (Zhaoqing)	Max	0.247	0.311	0.407	0.200	0.178	0.114	0.140	0.151	0.118	0.164	0.163	0.148
	Min	0.000	0.003	0.003	0.002	0.001	0.003	0.004	0.004	0.002	0.002	0.002	0.000
Xiapu (Huizhou)	Max	0.155	0.176	0.240	0.207	0.107	0.127	0.148	0.149	0.114	0.182	0.176	0.244
	Min	0.004	0.001	0.006	0.004	0.005	0.004	0.005	0.004	0.003	0.010	0.002	0.005
Jinguowan (Huizhou)	Max	0.132	0.178	0.199	0.155	0.189	0.183	0.214	0.225	0.180	0.247	0.132	0.166
	Min	0.002	0.001	0.002	0.000	0.004	0.001	0.000	0.004	0.007	0.011	0.004	0.005
Nanchengyuanling (Dongguan)	Max	0.191	0.262	0.316	0.172	0.099	0.126	0.157	0.175	0.142	0.202	0.197	0.267
	Min	0.003	0.008	0.005	0.003	0.006	0.006	0.003	0.004	0.010	0.006	0.003	0.001
Zimaling Park (Zhongshan)	Max	0.248	0.314	0.370	0.153	0.119	0.144	0.172	0.196	0.175	0.198	0.289	0.326
	Min	0.000	0.004	0.000	0.003	0.001	0.002	0.002	0.001	0.003	0.011	0.004	0.003
Tsuen Wan (HKSAR)	Max	0.180	0.142	0.244	0.142	0.089	0.122	0.171	0.170	0.097	0.180	0.135	0.135
	Min	0.008	0.006	0.005	0.003	0.004	0.003	0.004	0.005	0.003	0.002	0.001	0.004
Tap Mun (HKSAR)	Max	0.117	0.114	0.224	0.146	0.070	0.099	0.140	0.123	0.101	0.138	0.108	0.145
	Min	0.003	0.004	0.008	0.007	0.005	0.004	0.003	0.004	0.003	0.005	0.003	0.005
Tung Chung (HKSAR)	Max	0.221	0.207	0.299	0.252	0.115	0.174	0.188	0.204	0.129	0.226	0.203	0.189
	Min	0.008	0.003	0.009	0.002	0.006	0.005	0.002	0.004	0.004	0.012	0.008	0.006

Table 3.4b : The monthly maxima and minima of daily averages of Respirable Suspended Particulates
 [Class 2 NAAQS (Daily) : 0.15 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Days	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.141	0.165	0.248	0.153	0.111	0.109	0.088	0.114	0.131	0.165	0.112	0.127	8	2.28%
	Min	0.024	0.032	0.037	0.058	0.055	0.039	0.033	0.039	0.035	0.028	0.018	0.020		
Wanqingsha (Guangzhou)	Max	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Min	--	--	--	--	--	--	--	--	--	--	--	--		
Tianhu (Guangzhou)	Max	0.079	0.134	0.148	0.125	0.065	0.081	0.069	0.100	0.097	0.168	0.107	0.083	2	0.59%
	Min	0.002	0.010	0.010	0.015	0.017	0.012	0.007	0.012	0.016	0.031	0.005	0.005		
Liyuan (Shenzhen)	Max	0.100	0.098	0.171	0.092	0.068	0.064	0.076	0.115	0.106	0.106	0.117	0.142	1	0.29%
	Min	0.010	0.016	0.022	0.009	0.015	0.013	0.009	0.015	0.011	0.050	0.041	0.025		
Tangjia (Zhuhai)	Max	0.105	0.094	0.169	0.096	0.053	0.061	0.093	0.111	0.113	0.146	0.085	0.136	1	0.30%
	Min	0.011	0.016	0.019	0.008	0.018	0.022	0.015	0.015	0.014	0.037	0.028	0.017		
Jinjuzui (Foshan)	Max	0.133	0.169	0.315	0.115	0.058	0.072	0.105	0.106	0.135	0.178	0.185	0.210	12	3.43%
	Min	0.014	0.035	0.032	0.024	0.027	0.021	0.015	0.023	0.025	0.043	0.033	0.033		
Huijingcheng (Foshan)	Max	0.156	0.188	0.303	0.157	0.090	0.100	0.168	0.133	0.132	0.219	0.173	0.220	29	8.24%
	Min	0.018	0.038	0.048	0.040	0.037	0.025	0.018	0.035	0.036	0.046	0.038	0.032		
Donghu (Jiangmen)	Max	0.079	0.143	0.168	0.143	0.097	0.090	0.123	0.115	0.143	0.147	0.107	0.131	2	0.57%
	Min	0.008	0.023	0.027	0.026	0.022	0.021	0.017	0.028	0.028	0.034	0.029	0.028		
Chengzhong (Zhaoqing)	Max	0.154	0.192	0.262	0.121	0.093	0.065	0.067	0.076	0.083	0.112	0.100	0.103	6	1.75%
	Min	0.011	0.020	0.027	0.025	0.016	0.016	0.011	0.015	0.018	0.010	0.014	0.012		
Xiapu (Huizhou)	Max	0.117	0.111	0.137	0.100	0.065	0.076	0.096	0.102	0.091	0.113	0.088	0.147	0	0.00%
	Min	0.017	0.016	0.016	0.019	0.017	0.021	0.015	0.016	0.020	0.037	0.018	0.015		
Jinguowan (Huizhou)	Max	0.105	0.110	0.154	0.094	0.068	0.074	0.109	0.137	0.099	0.124	0.095	0.093	1	0.32%
	Min	0.010	0.015	0.025	0.024	0.029	0.023	0.020	0.025	0.025	0.042	0.033	0.022		
Nanchengyuanling (Dongguan)	Max	0.125	0.144	0.156	0.102	0.058	0.074	0.084	0.131	0.108	0.154	0.120	0.158	3	0.85%
	Min	0.012	0.027	0.021	0.022	0.026	0.019	0.015	0.024	0.028	0.041	0.021	0.019		
Zimaling Park (Zhongshan)	Max	0.143	0.148	0.196	0.105	0.047	0.078	0.111	0.117	0.109	0.143	0.143	0.209	5	1.43%
	Min	0.007	0.020	0.010	0.017	0.012	0.016	0.008	0.019	0.017	0.029	0.027	0.034		
Tsuen Wan (HKSAR)	Max	0.108	0.098	0.186	0.096	0.057	0.066	0.078	0.108	0.085	0.102	0.095	0.090	1	0.27%
	Min	0.018	0.022	0.022	0.021	0.017	0.016	0.009	0.014	0.012	0.032	0.021	0.020		
Tap Mun (HKSAR)	Max	0.101	0.095	0.165	0.086	0.056	0.064	0.044	0.095	0.087	0.101	0.088	0.097	1	0.28%
	Min	0.017	0.014	0.019	0.017	0.010	0.014	0.011	0.014	0.010	0.034	0.013	0.017		
Tung Chung (HKSAR)	Max	0.153	0.110	0.177	0.113	0.044	0.063	0.091	0.112	0.099	0.129	0.110	0.093	3	0.85%
	Min	0.023	0.019	0.024	0.014	0.012	0.013	0.007	0.012	0.011	0.042	0.024	0.024		

Table 3.4c : The monthly and annual averages of Respirable Suspended Particulates**[Class 2 NAAQS (Annual) : 0.10 mg/m³]**

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.061	0.078	0.113	0.089	0.079	0.067	0.054	0.073	0.065	0.093	0.063	0.069	0.076
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.034	0.047	0.057	0.044	0.041	0.041	0.032	0.051	0.049	0.092	0.051	0.041	0.048
Liyuan (Shenzhen)	0.045	0.046	0.052	0.044	0.034	0.031	0.024	0.052	0.047	0.073	0.072	0.065	0.048
Tangjia (Zhuhai)	0.058	0.049	0.059	0.042	0.029	0.036	0.027	0.050	0.052	0.072	0.055	0.060	0.049
Jinjuzui (Foshan)	0.070	0.079	0.101	0.058	0.042	0.043	0.038	0.062	0.057	0.098	0.084	0.095	0.069
Huijingcheng (Foshan)	0.070	0.092	0.124	0.080	0.059	0.056	0.049	0.077	0.071	0.118	0.096	0.101	0.083
Donghu (Jiangmen)	0.042	0.053	0.078	0.063	0.048	0.046	0.038	0.061	0.057	0.081	0.058	0.066	0.058
Chengzhong (Zhaoqing)	0.062	0.085	0.092	0.060	0.046	0.031	0.031	0.045	0.037	0.066	0.049	0.050	0.054
Xiapu (Huizhou)	0.057	0.054	0.065	0.046	0.037	0.041	0.033	0.050	0.044	0.076	0.055	0.064	0.052
Jinguowan (Huizhou)	0.046	0.050	0.062	0.054	0.045	0.050	0.047*	0.061	0.054	0.084	0.065	0.053	0.056
Nanchengyuanling (Dongguan)	0.058	0.069	0.080	0.047	0.042	0.042	0.034	0.057	0.055	0.089	0.066	0.074	0.059
Zimaling Park (Zhongshan)	0.064	0.070	0.068	0.042	0.029	0.035	0.028	0.056	0.055	0.078	0.079	0.096	0.058
Tsuen Wan (HKSAR)	0.057	0.048	0.053	0.047	0.032	0.035	0.026	0.048	0.041	0.068	0.049	0.047	0.046
Tap Mun (HKSAR)	0.046	0.040	0.051	0.042	0.029	0.030	0.018	0.041	0.037	0.065	0.045	0.049	0.041
Tung Chung (HKSAR)	0.074	0.054	0.062	0.045	0.026	0.031	0.019	0.044	0.042	0.080	0.057	0.055	0.049

Remarks :

1. All concentration units are in milligrams per cubic metre.
2. “*” denotes that the data capture rate does not meet the minimum requirements for determining a representative value.

3.5 Monthly Variations of Pollutant Concentrations

Figure 8 shows the monthly variations of the major pollutants (SO_2 , NO_2 , O_3 , and PM_{10}) recorded by the Network in 2012. The overall concentrations of SO_2 , NO_2 and PM_{10} were generally higher during the winter season (first and fourth quarters of year) and relatively lower in the summer months. The lower pollutants levels in summer were mainly due to the relatively clean maritime air stream prevailed in the PRD region under the influence of southern monsoon together with heavier rainfall and higher mixing layer height that favoured the dispersion of pollutants. As for ozone, the highest monthly averages occurred in August, September and October because of more days in the period with meteorological conditions that favoured photochemical reactions (such as strong solar radiation, less amount of clouds, weak wind speed etc.), hence causing more ozone formation.

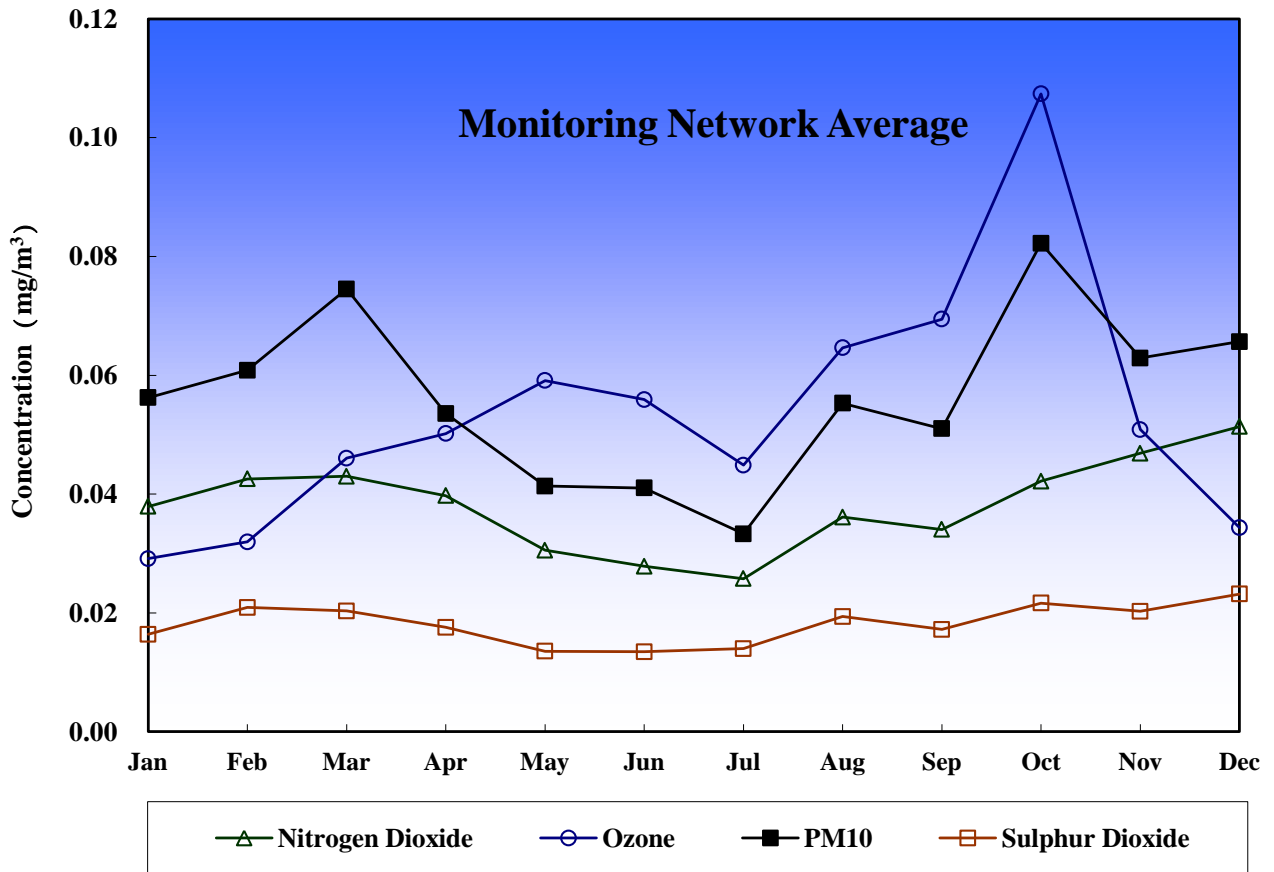


Figure 8 : Monthly variations of average pollutant concentrations measured by the Network

3.6 Annual Variations of Pollutant Concentrations (2006-2012)

Table 3.6 shows the annual mean concentrations of the major pollutants (SO₂, NO₂, O₃, and PM₁₀) recorded by the Network from 2006 to 2012.

From 2006 to 2012, the annual averages recorded by the Network for SO₂, NO₂, and PM₁₀ decreased by 62%, 17% and 24% respectively. These reductions indicated that the measures implemented in recent years by Guangdong and Hong Kong, including the retrofitting of power plants with flue-gas desulphurization facilities, tightening the vehicle emission standards and fuel specifications, phasing out the more polluting industrial facilities in the PRD, etc., had brought improvements in the overall air quality in the Pearl River Delta region. However, the Network had recorded an increase of 13% in the annual ozone average in the same period, reflecting that the photochemical smog pollution in the region has not yet improved. The Guangdong and Hong Kong governments will continue to implement emission reduction measures to further improve the air quality in the region and tackle the photochemical pollution problem.

Table 3.6 : Annual averages of the pollutants from the monitoring network

	Sulphur Dioxide	Nitrogen Dioxide	Ozone	Respirable Suspended Particulates
2006	0.047	0.046	0.048	0.074
2007	0.048	0.045	0.051	0.079
2008	0.039	0.045	0.051	0.070
2009	0.029	0.042	0.056	0.069
2010	0.025	0.043	0.053	0.064
2011	0.024	0.040	0.058	0.064
2012	0.018	0.038	0.054	0.056

Remark : All concentration units are in milligrams per cubic metre.

4. Statistical Analysis of the Regional Air Quality Index (RAQI)

The two governments of Guangdong and HKSAR jointly started the daily reporting of the RAQI since 30 November 2005 to provide the public with information about the air quality in different parts of the PRD region.

The RAQI is a composite indicator of the aggregate level of the four major regional air pollutants, namely sulphur dioxide (SO₂), nitrogen dioxide (NO₂), ozone (O₃) and respirable suspended particulates (PM₁₀). The higher the index value, the higher the regional air pollution levels. The RAQI is divided into the following five grades:

Grade	Regional Air Quality Index (RAQI) value [#]	Air Quality Condition in the Monitored Area
I	0 – 1	Concentrations of all pollutants are well within Class 2 of the National Ambient Air Quality Standards (NAAQS)
II	1 – 2	Concentrations of all pollutants are generally within Class 2 NAAQS
III	2 – 3	Concentrations of individual pollutants may approach or exceed Class 2 NAAQS
IV	3 – 4	Class 2 NAAQS are generally exceeded
V	>4	Class 2 NAAQS are significantly exceeded

The formula for calculating the RAQI is as follows:

$$I_c = \sum_{i=1}^4 \frac{C_i}{R_i}$$

where I_c stands for the RAQI, an indicator of the aggregate pollution level of four pollutants, namely, SO₂, NO₂, O₃ and PM₁₀. For SO₂, NO₂ and PM₁₀, C_i is the daily average concentration while R_i represents the daily average concentration limits of the corresponding pollutants as specified in Class 2 NAAQS. For O₃, C_i is the highest hourly average of a day while R_i represents the hourly average concentration limit in Class 2 NAAQS (refer to Class 2 NAAQS (GB 3095 – 1996) revised version).

[#] The upper limits of the range of Grades I, II, III and IV of the RAQI are inclusive.

4.1 Statistics on RAQI Grades

Table 4.1 summarise the statistics on the RAQI grades and effective days of RAQI for all monitoring stations in the Network from January to December 2012.

Table 4.1 : Statistics on RAQI grades of individual monitoring stations

Monitoring Stations	District	Days with valid RAQI	Ratio of valid RAQI	Distribution of RAQI grades in 2012 (%)				
				Grade I	Grade II	Grade III	Grade IV	Grade V
Luhu Park	Guangzhou	355	97%	18.31	49.30	30.14	2.25	0.00
Wanqingsha	Guangzhou	--	--	--	--	--	--	--
Tianhu	Guangzhou	340	93%	47.35	49.71	2.94	0.00	0.00
Liyuan	Shenzhen	352	96%	46.88	47.16	5.97	0.00	0.00
Tangjia	Zhuhai	339	93%	41.89	48.97	9.14	0.00	0.00
Jinjuzui	Foshan	350	96%	21.43	50.29	25.43	2.86	0.00
Huijingcheng	Foshan	346	95%	10.12	49.71	32.95	6.65	0.58
Donghu	Jiangmen	352	96%	35.23	50.00	13.92	0.85	0.00
Chengzhong	Zhaoqing	334	91%	30.54	50.30	16.47	2.69	0.00
Xiapu	Huizhou	354	97%	33.90	59.32	6.78	0.00	0.00
Jinguowan	Huizhou	335	92%	47.46	50.45	2.09	0.00	0.00
Nanchengyuanling	Dongguan	342	93%	19.88	52.63	25.73	1.75	0.00
Zimaling Park	Zhongshan	347	95%	36.89	48.13	13.83	0.86	0.29
Tsuen Wan	HKSAR	346	95%	33.24	56.36	9.83	0.58	0.00
Tap Mun	HKSAR	340	93%	53.53	44.12	2.35	0.00	0.00
Tung Chung	HKSAR	347	95%	36.89	47.26	14.41	1.44	0.00

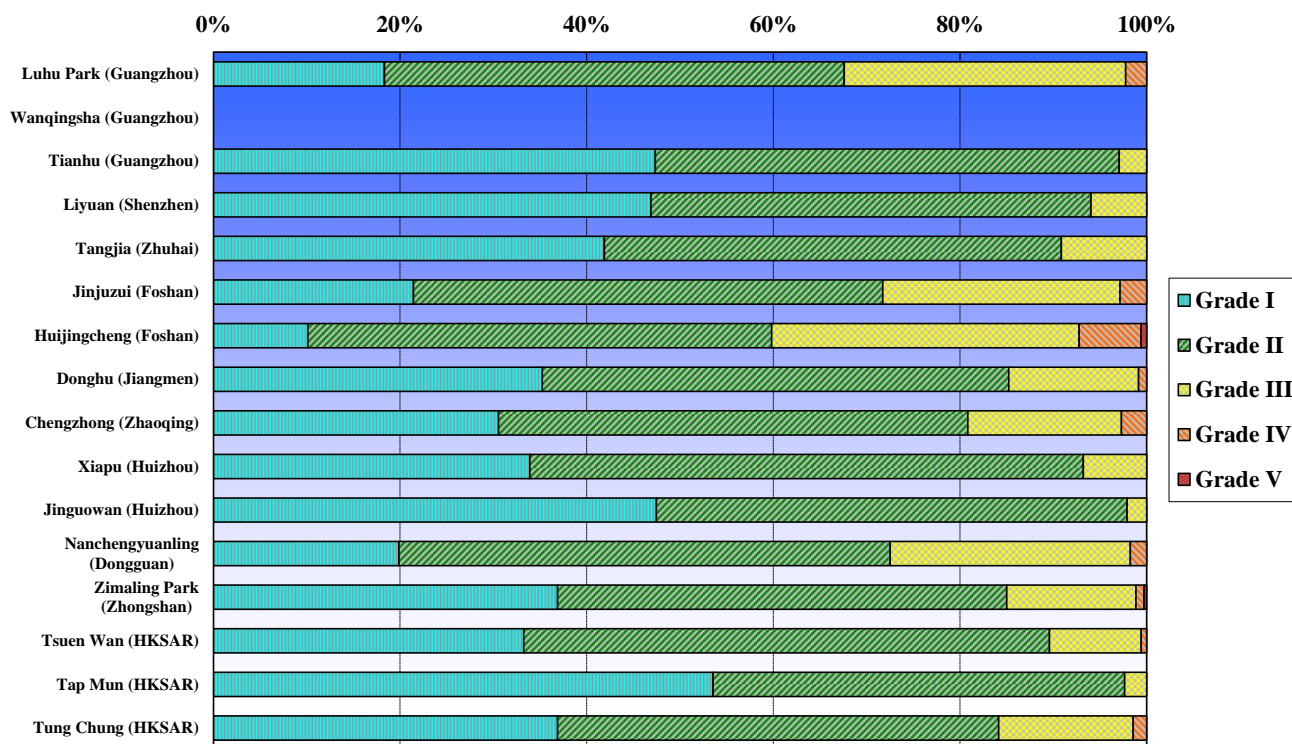


Figure 9 : Stacked column chart of RAQI grades of individual monitoring stations

Figure 10 shows the overall distribution of different RAQI grades recorded by the Network in 2012. As a whole, 84.4% of the RAQI values are at Grade I to II, meaning the pollutant concentrations are generally within Class 2 of the NAAQS, followed by 14.2% at Grade III, 1.3% at Grade IV and 0.1% at Grade V.

Distribution of RAQI Grades (Jan - Dec)

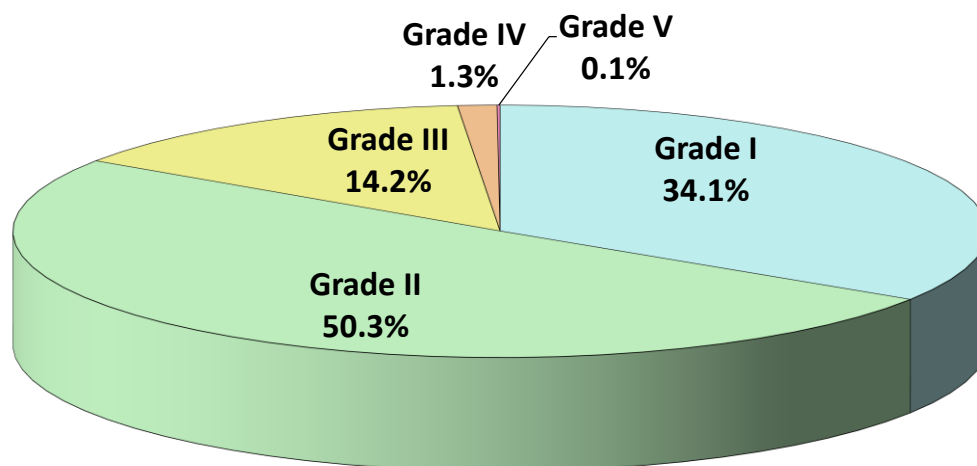


Figure 10 : Distribution of RAQI grades in the Network

4.2 Spatial Distribution of Average RAQI at Monitoring Stations in the Network

Figure 11 shows the spatial distribution of RAQI annual average in 2012 at monitoring stations in the network. The average values for all monitoring stations were among at Grade II.

Distribution of average RAQI from Jan 2012 to Dec 2012

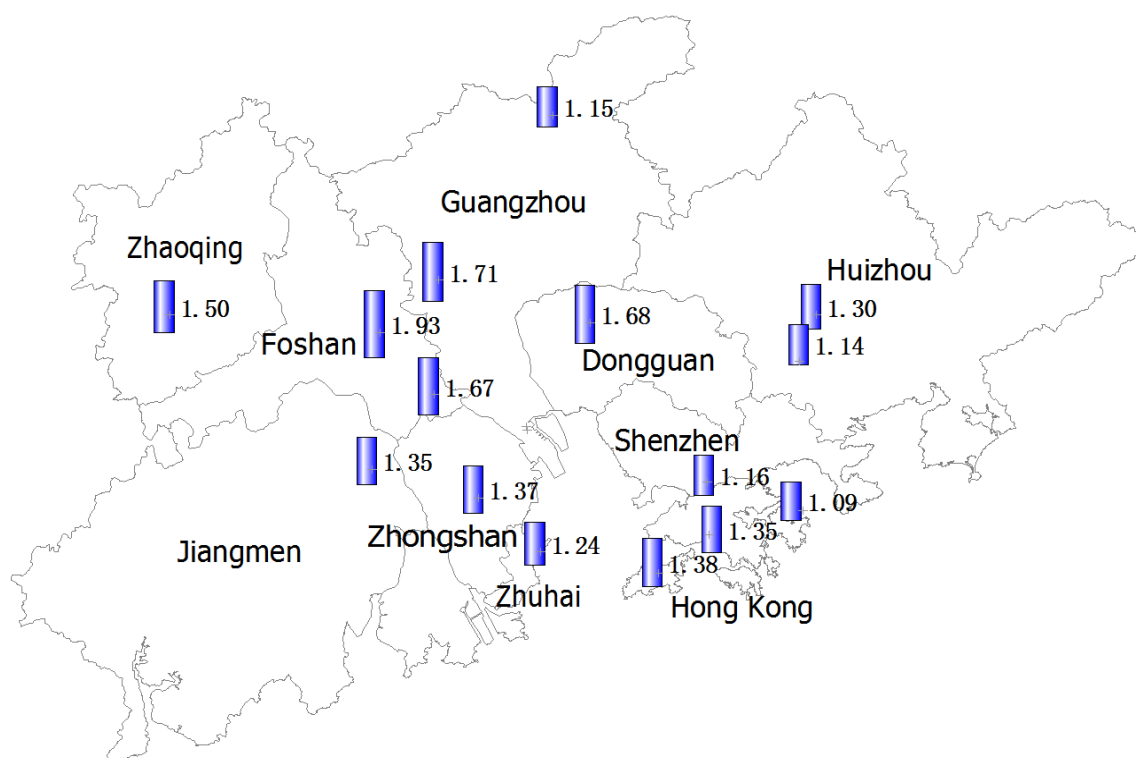


Figure 11 : Spatial distribution of average RAQI at Monitoring Stations in the Network

4.3 Monthly Variations of Average RAQI

Figure 12 shows the monthly variations in the average RAQI values of the Network from January to December 2012. During the year, all monthly average RAQI were within the Grade II category, except for October. The maximum and minimum RAQI values were recorded in October and July respectively.

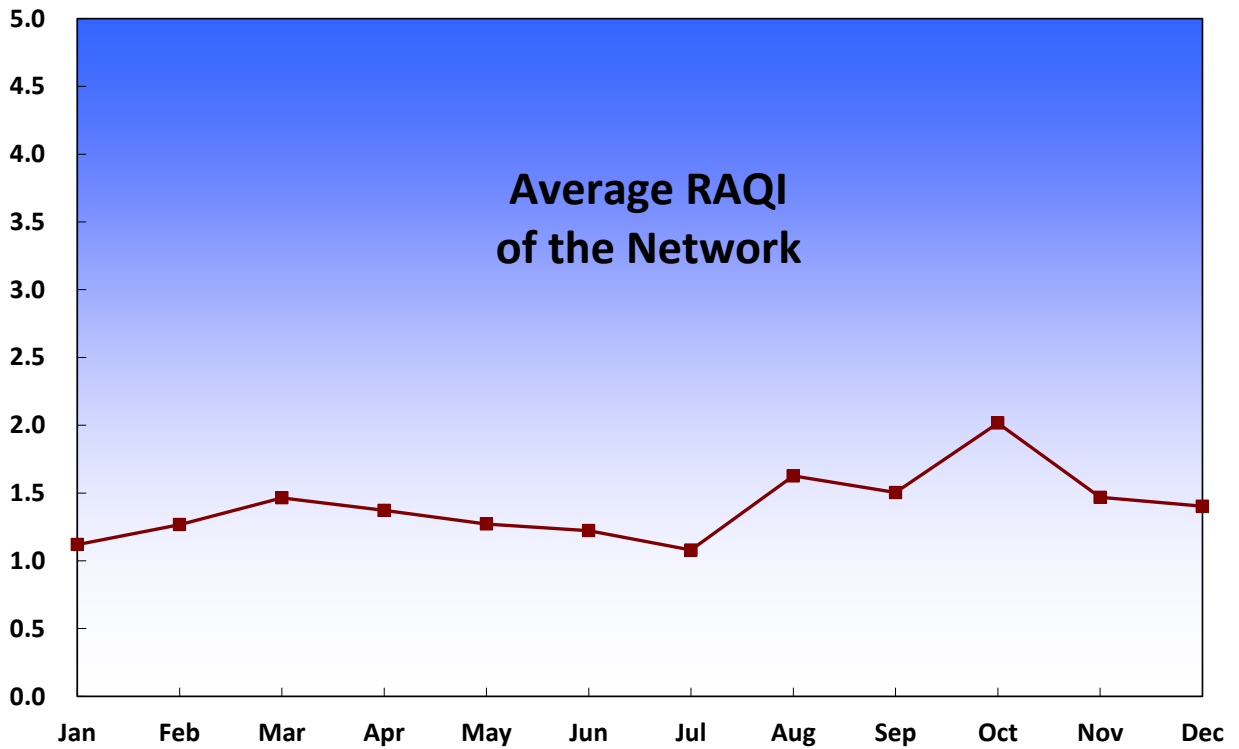


Figure 12 : Monthly variations in average RAQI

Annex A : Site Information of Monitoring Stations

Monitoring Stations	Address	Area Type	Sampling Height (Above P.D.)	Above Ground	Date Commenced Operation
Luhu Park (Guangzhou)	Inside Jufong Garden of Luhu Park (Big yard, No. 11 Luhu Park)	City	30m	9m	1993
Wanqingsha (Guangzhou)	Wanqingsha Secondary School, Nansha	Mixed educational/commercial and residential/industrial	13m	12m	Oct 2004
Tianhu (Guangzhou)	Tianhu Park, Conghua City	Background : rural	251m	13m	Oct 2004
Liyuan (Shenzhen)	Shennan Zhong Road, Shenzhen City	City	38m	12m	Sep 1997
* Tangjia (Zhuhai)	Qiao Island Mangrove Monitoring Station, Tangjia County	Mixed educational/commercial and residential/industrial	13m	13m	Jan 2010
Jinjuzui (Foshan)	Roof-top of Educational Building, Foshan City Communist Party Shunde Jinjuzui	Tourist and cultural /educational	27m	17m	Oct 1999
Huijingcheng (Foshan)	No. 127, Fenjiang Nan Road, Chancheng Area	Urban: mixed residential/commercial/ industrial	24m	14m	Feb 2000
Donghu (Jiangmen)	Inside Donghu Park, Jiangmen City	City	17.5m	5m	Nov 2001
Chengzhong (Zhaoqing)	No. 17, Qintian Road, Zhaoqing City	Urban: mixed residential/commercial	21m	16m	Jun 2001
Xiapu (Huizhou)	No. 4 Xiabuhengjiang Road No. 3, Huicheng Area	Urban: commercial	49m	20m	Dec 1999
Jinguowan (Huizhou)	Jinguowan Ecological Farm, Huizhou City	Residential	77m	8m	Oct 2004
* Nanchengyuanling (Dongguan)	Nanchengyuanling Community, Dongguan City	Mixed residential/commercial/industrial	33 m	18m	Sep 2010
Zimaling Park (Zhongshan)	Zimaling Park, Zhongshan City	Mixed residential/commercial	45 m	7m	Aug 2002
Tsuen Wan (HKSAR)	60 Tai Ho Road, Tsuen Wan	Urban: mixed residential/commercial/ industrial	21m	17m	Aug 1988
Tap Mun (HKSAR)	Tap Mun Police Station	Background: rural	26m	11m	Apr 1998
Tung Chung (HKSAR)	6 Fu Tung Street, Tung Chung	New Town: residential	34.5m	27.5m	Apr 1999

Remarks *: As a result of the expansion cum adjustment of the Zhuhai air monitoring network under the approval of the Ministry of Environmental Protection, the original site of Zhuhai Tangjia monitoring station at Zhongshan University was relocated to Qiao Island from 1 March 2012. The name of the station remains unchanged.

The Dongguan Haogong Primary School monitoring station was relocated to Nanchengyuanling in the vicinity and renamed Nanchengyuanling station from 1 January 2012 because the representativeness of the original site had been affected by urban development in the locality.

Annex B : Measurement Methods of Air Pollutant Concentration

Pollutants	Measuring Principles
Sulphur Dioxide	UV fluorescence / Differential Optical Absorption Spectroscopy
Nitrogen Dioxide	Chemiluminescence / Differential Optical Absorption Spectroscopy
Ozone	UV absorption / Differential Optical Absorption Spectroscopy
Respirable Suspended Particulates	Oscillating microbalance (TEOM) Beta particulate monitor